REMARKS

This is a full and timely response to the final Office Action mailed July 16, 2004. Claims 13 and 17-38 remain pending. Through this response, claims 14-16 have been cancelled, and claims 13, 33, 37 and 38 have been amended. Reconsideration and allowance of the application and pending claims are respectfully requested.

I. Claim Rejections - 35 U.S.C. § 103(a)

A. Rejection of Claims

Claims have been rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over *Newell* ('356), *Newell* ('787) or *Nakamura* in view of *Takashi*. The Office Action was unclear as to which claims the rejection applies, but for purposes of discussion, the Applicant will assume the rejection applies to claims 13-15, 17-36, and 38. Claims 16 and 37 have been rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over *Newell* ('356), *Newell* ('787) or *Nakamura* in view of *Takashi* as applied to claim 13 above, and further in view of *Staudte* ('616). Applicant respectfully traverses this rejection.

B. The *Staudte* Reference

The *Staudte* reference discloses a piezoelectric tuning fork mounted in a package having a transparent region through which the microresonator can be tuned using a laser beam. The package includes a capacitor that uses the package wall as a dielectric. (See Abstract.) The laser provides for coarse adjustment of the resonant frequency. The capacitor enables the frequency to be adjusted slightly by shorting together capacitor plate sections on the outside of the package. (See Abstract.)

In contrast to the Applicant's claimed invention, *Staudte* does not disclose, teach, or suggest a resonating member ***having a bi-directionally adjustable resonance frequency***. The other cited references do not remedy this deficiency. The frequency adjustment disclosed in *Staudte* is unidirectional, and irreversible. As provided in col. 3, lines 49-54 (with emphasis added):

> The laser beam projects through the substrate 18 to remove excess thick film material, thereby decreasing the mass of weights 20 and increasing the microresonator 16 frequency to a desired value.

Thus, in *Staudte*, an irreversible process is described whereby the frequency can only be adjusted in one direction, not ***bi-directionally***, by removing material. The capacitors in *Staudte* provide for fine tuning of the resonance frequency in a sense that the large frequency steps effected through mass removal by the laser are reduced by shorting capacitor segments together.

Also, in contrast to Applicant's claimed invention, *Staudte* does not disclose, teach, or suggest ***a capacitor created by the semiconductor material and the handle layer separated by an air gap formed out of the oxide layer***, as recited in claim 13. This claim language clearly describes an integrated capacitor, as acknowledged by the Office Action. Referring to FIG. 1 in *Staudte* (and column 6 of the specification), the "capacitor 75 is external to the microresonator 16," and thus not integrated. The other references do not remedy this deficiency.

Also, in contrast to Applicant's claimed invention, *Staudte* does not disclose, teach, or suggest a capacitor that has an ***air gap*** as the dielectric. As provided in col. 6, lines 21-

22, *Staudte* provides that the "capacitor 75 uses the substrate 18 as a dielectric," which is not an ***air gap***. The other references do not remedy this deficiency.

C. Discussion of the Rejection

As has been acknowledged by the Court of Appeals for the Federal Circuit, the U.S. Patent and Trademark Office ("USPTO") has the burden under section 103 to establish a proper case of obviousness by showing some objective teaching in the prior art or generally available knowledge of one of ordinary skill in the art that would lead that individual to the claimed invention. See *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988). Accordingly, to make a proper case for obviousness, there must be a prior art teaching or established knowledge that would suggest to a person having ordinary skill in the pertinent art to fill the voids apparent in the applied reference. It is respectfully asserted that no such case has been made in the outstanding Office Action.

The Office Action alleges, in relevant part, the following:

> Newell (256)_(figs. 1-4, 6 and 7), Newell (787) figs. 1-5, 7 and 8 Nakamura ...do not explicitly teach an oxide layer over the over the semiconductor layer. However, the references do teach providing an insulating layer on the semiconductor with an electric conductor on top of the insulator. These references also do not use a semiconductor on insulator wafer configuration. However, Takahaski (see e.g. col. 1, line 12-col. 2 line 21) teaches a silicon on insulator substrate allows increased density of integrated units as well as increased heat dissipation. Thus for at least these reasons it would have been obvious to one of ordinary skill in the art to use a silicon on insulator substrate in lieu of the silicon substrate used by Newell or Nakamura.

With regard to claims 16 and 37, the Office Action alleges the following in relevant part:

> These claims add that a capacitor is integrated with the piezo resonator to adjust the resonant frequency. Staudte (616) shows capacitors are often integrated with piezo resonators for adjusting the frequency response of the device. Thus to provide adjustability to Newell or Nakamura it would have been obvious to one of ordinary sill in the art to integrate a capacitor with these resonators. Any piezo resonator is adjustable (i.e. capable of being adjusted) via addition or substration of mass, changing degree of polization or stiffness of the device.

Applicant has amended claim 13 to incorporate the limitations found in claims 14-16, and has also added the limitations of bi-directional resonance frequency adjustment and has clarified that the gap formed from the oxide layer is an air gap. Thus, the discussion below will address the arguments presented in the Office Action as they relate to like-limitations found in independent claim 13, with the understanding that similar arguments apply to like limitations found for the resonator structure found in independent claim 33, also amended in like manner.

Independent claim 13 is reproduced below, and provides as follows (with emphasis added):

> 13. A piezoelectric resonator, including:
>
> a resonating member ***having a bi-directionally adjustable resonance frequency***, said resonating member including:
>
> a semiconductor material of a semiconductor-on-insulator wafer, the semi-conductor-on-insulator wafer including an oxide layer adjacent to the semiconductor material and a handle layer adjacent to the oxide layer, the oxide layer disposed between the handle layer and the semiconductor material;
>
> an electrode;
>
> a piezoelectric material disposed between the semiconductor material and the electrode; and
>
> ***a capacitor created by the semiconductor material and the handle layer separated by an air gap formed out of the oxide layer***, wherein

the capacitor is configured to receive a direct current voltage that adjusts the resonance frequency of the resonating member.

As an initial matter, the claimed structure enables the bi-directional frequency adjustment features. The semiconductor material and the handle layer comprise two plates, separated by an air gap. The air gap enables freedom of vibratory movement by the semiconductor material. When a dc voltage is applied to the structure described by claim 13, the stiffness of the semiconductor material is changed. This changed stiffness (a negative stiffness) is manifested as a movement of the semiconductor material into the area defined by the gap, thus reducing the gap area. By reducing the gap area, the resulting capacitance is changed, with the capacitor now acting as a negative capacitance. In terms of resonance frequency, the negative stiffness results in a gap area change which causes a decrease in resonance frequency. By returning the dc voltage to its original voltage level, the air gap returns to its original area, resulting in frequency adjustment in the opposite (increasing frequency) direction. Generally, in operation, the dc voltage applied to the structure defined by claim 13 is at a predetermined bias level, such that the voltage level can be increased and decreased from that bias level to provide frequency adjustment in the increasing and decreasing direction. Thus, the structure enables vibratory movement that results in a variable gap area, which results in a variable capacitance to achieve the bi-directional frequency adjustment feature as claimed.

Applicant respectfully submits that none of the cited references disclose, teach, or suggest the emphasized claim limitations found in independent claim 13. As the Office Action acknowledges, and as evident from the language of claim 13, "[t]hese claims add that a capacitor is integrated with the piezo resonator to adjust the resonator frequency."

However, Applicant disagrees with the assertion that *Staudte* shows that capacitors are often integrated with piezo resonators. In fact, the capacitors in *Staudte* are disposed externally to the resonating member, and not integrated. None of the cited references correct this deficiency.

Further, none of the cited references disclose, teach, or suggest ***a capacitor created by the semiconductor material and the handle layer separated by an air gap formed out of the oxide layer***, as recited in claim 13. The *Takahaski* references discloses a SOI substrate, but does not show a capacitor structure that has an air gap formed out of the oxide layer. As discussed above, the *Staudte* reference discloses a capacitor that is external to the resonating structure. Neither these references or others cited remedy this deficiency.

Additionally, none of the cited references disclose, teach, or suggest a resonating member ***having a bi-directionally adjustable resonance frequency***, as recited in claim 13. As discussed above, the frequency adjustment described in *Staudte* is enabled in the increasing frequency direction only, not ***bi-directionally***.

Since none of the cited references disclose, teach, or suggest the emphasized features of independent claim 13, Applicant respectfully requests that the rejection to claim 13 be withdrawn.

Because independent claim 13 is allowable over the cited references, corresponding dependent claims 17-32 and 37-38 are allowable as a matter of law for at least the reason that dependent claims 17-32 and 37-38 contain all elements of their respective base claim. See, *e.g.*, *In re Fine*, 837 F.2d 1071 (Fed. Cir. 1988).

With regard to claim 33, as similar arguments supporting patentability for claim 13 apply for like limitations found for the resonator structure in claim 33, Applicant

respectfully requests that the rejection to claim 33 be withdrawn and corresponding dependent claims 34-36.

In summary, it is Applicant's position that a proper case for obviousness has not been made against Applicant's independent claims 13 and 33, or claims 17-32 and 37-38 and 34-36 which respectively depend therefrom. Therefore, it is respectfully submitted that each of these claims is patentable over the cited references and that the rejection of these claims should be withdrawn.

II. Canceled Claims

As identified above, claims 14-16 have been canceled from the application through this Response without prejudice, waiver, or disclaimer. Applicant reserves the right to present these canceled claims, or variants thereof, in continuing applications to be filed subsequently.

CONCLUSION

Applicant respectfully submits that Applicant's pending claims are in condition for allowance. Favorable reconsideration and allowance of the present application and all pending claims are hereby courteously requested. If, in the opinion of the Examiner, a telephonic conference would expedite the examination of this matter, the Examiner is invited to call the undersigned attorney at (770) 933-9500.

Respectfully submitted,

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I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail, postage prepaid, in an envelope addressed to: Assistant Commissioner for Patents, Alexandria, Virginia 22313-1450, on 9-16-04.

Signature